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Park et al.

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(54) **INPUT SYNTHESIS APPARATUS**

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F16H 3/72 (2006.01)

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(58) **Field of Classification Search**
None
See application file for complete search history.

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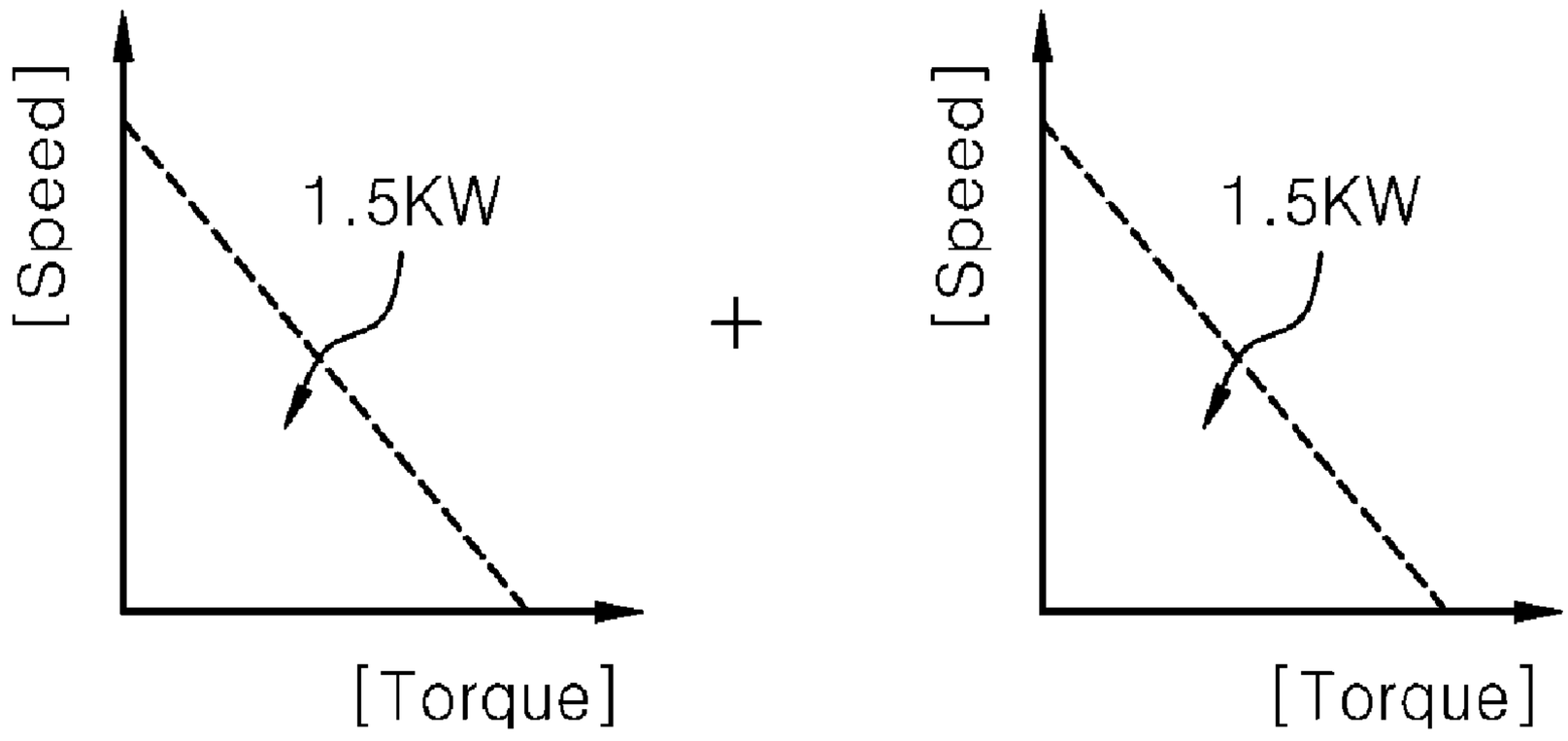
(57) **ABSTRACT**

An input synthesis apparatus according to the present invention includes: a first input unit which provides first rotational force; a second input unit which provides second rotational force equal to or different from the first rotational force; a gear unit which is engaged with the first input unit and the second input unit and synthesizes the first rotational force and the second rotational force; and an output unit which outputs resultant force of the first rotational force and the second rotational force, in which the gear unit sums up speeds or torque of the first rotational force and the second rotational force based on whether a rotation direction of the first input unit and a rotation direction of the second input unit are identical to each other.

11 Claims, 13 Drawing Sheets



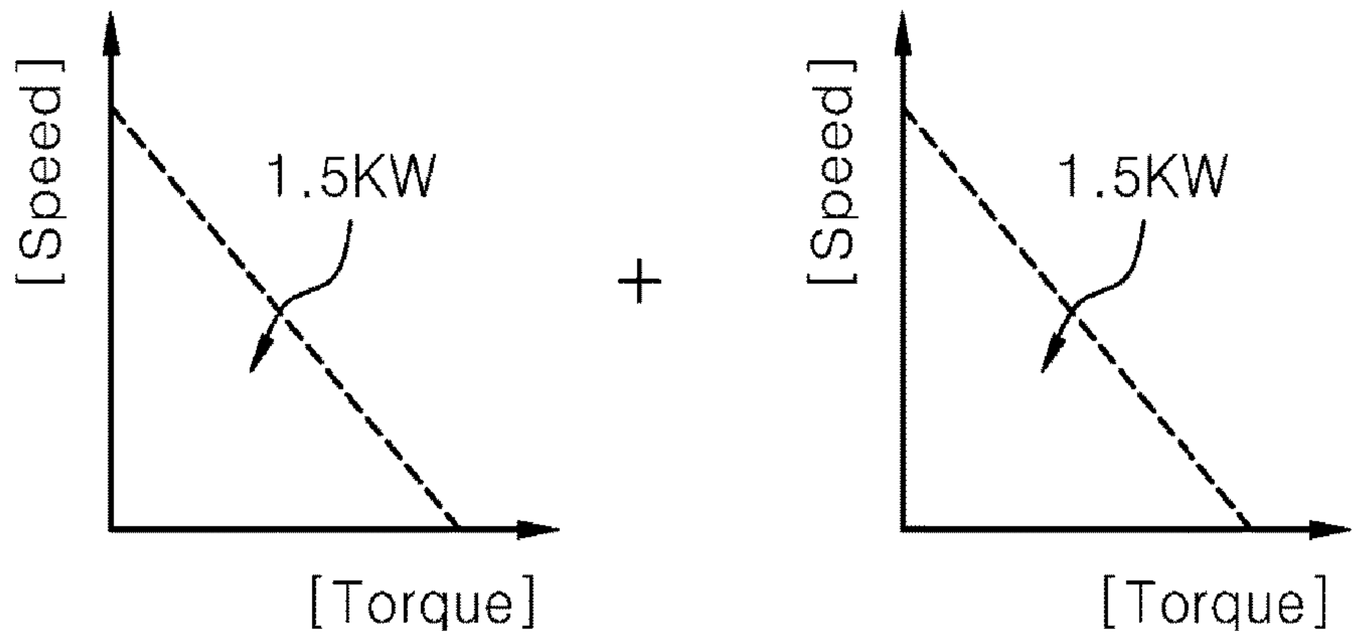

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FIG. 1

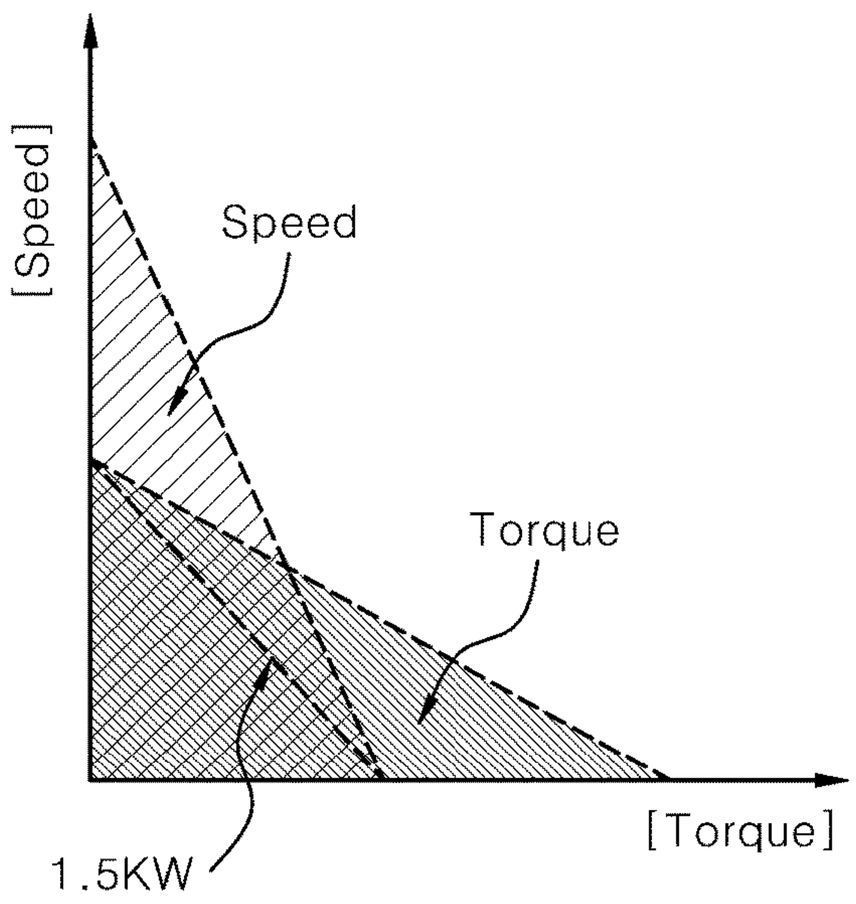
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FIG. 2

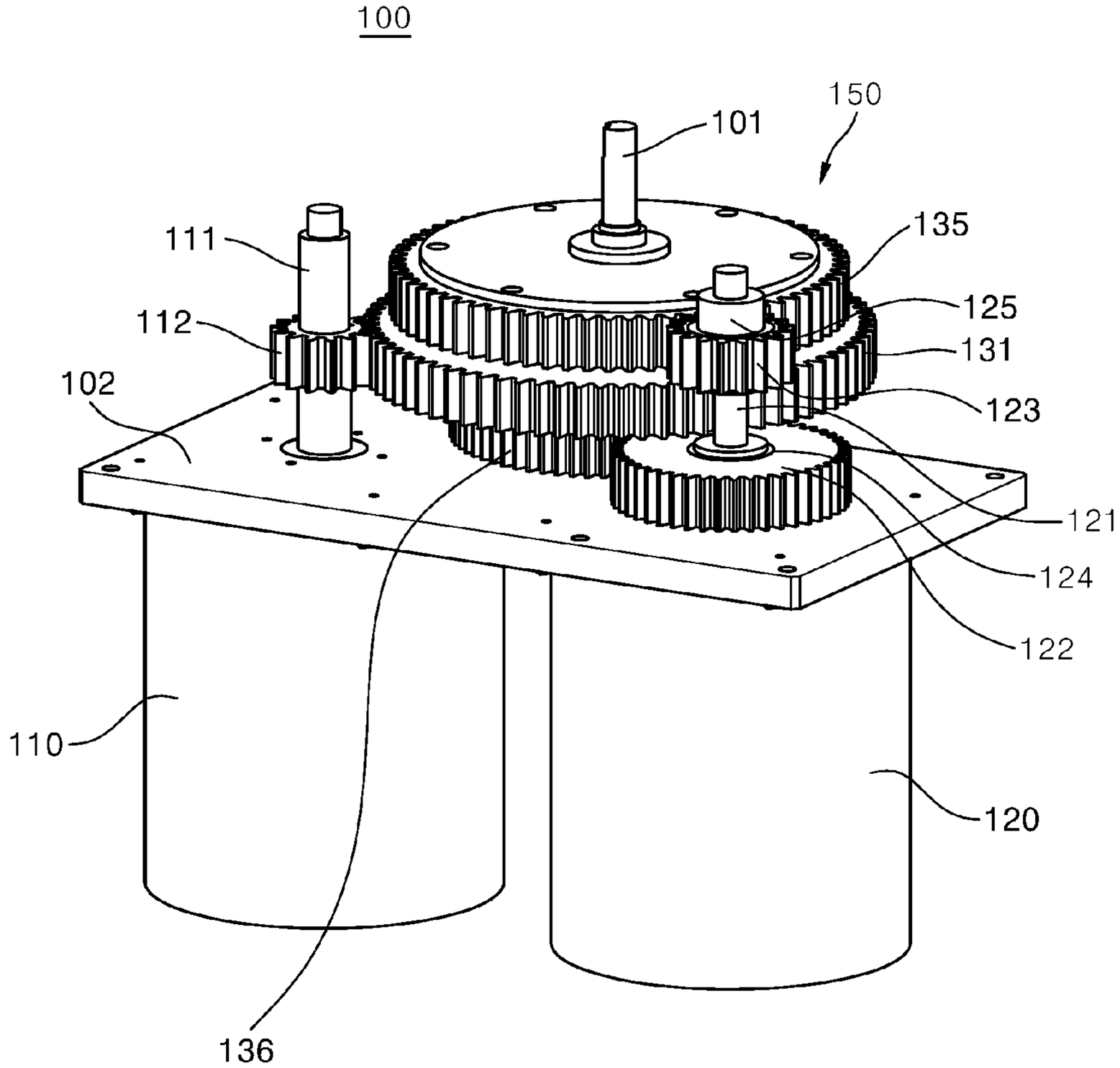

FIG. 3

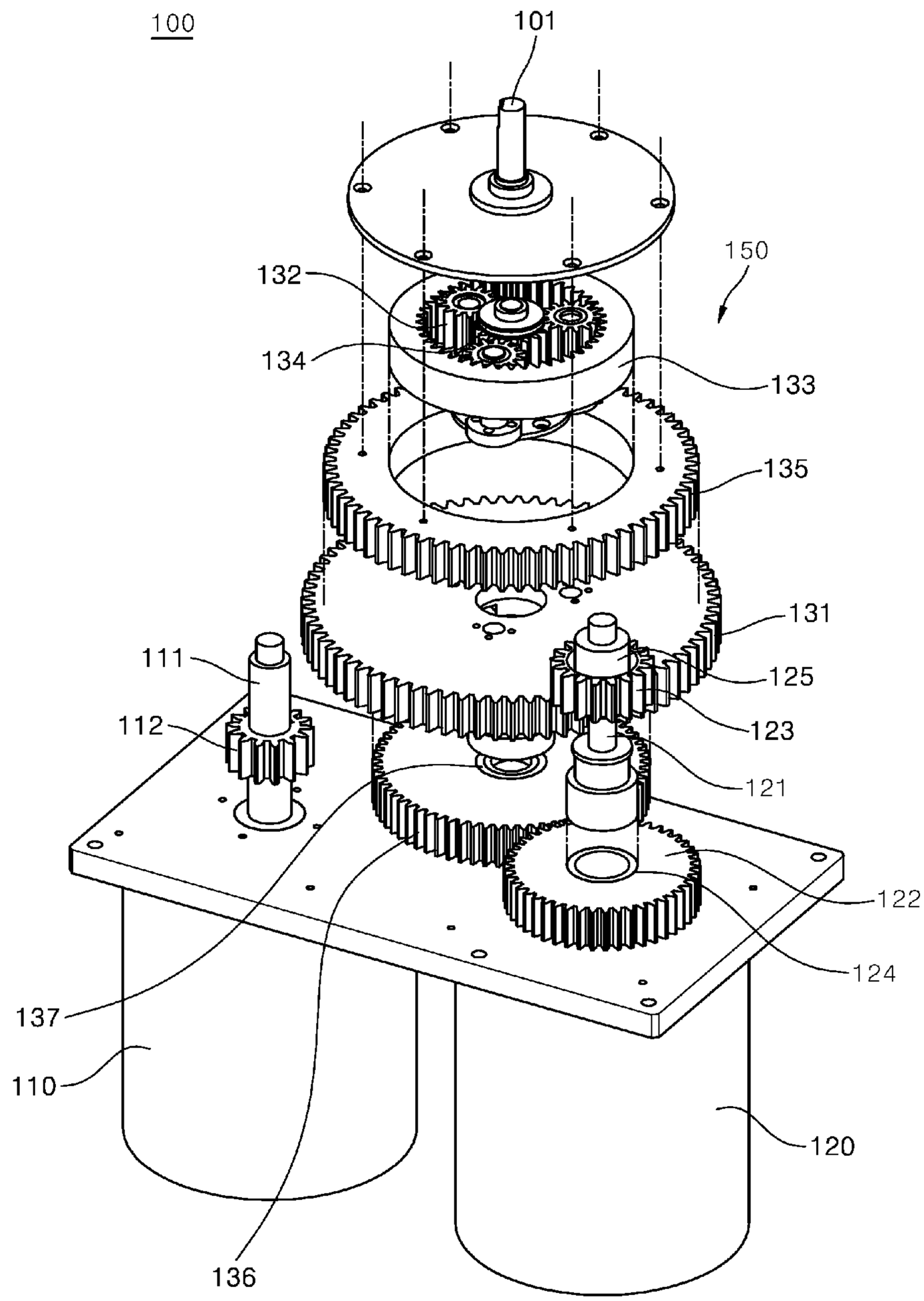
100
101
150
132
134
133
135
131
125
123
121
111
112
122
124
137
110
120
136

FIG. 4

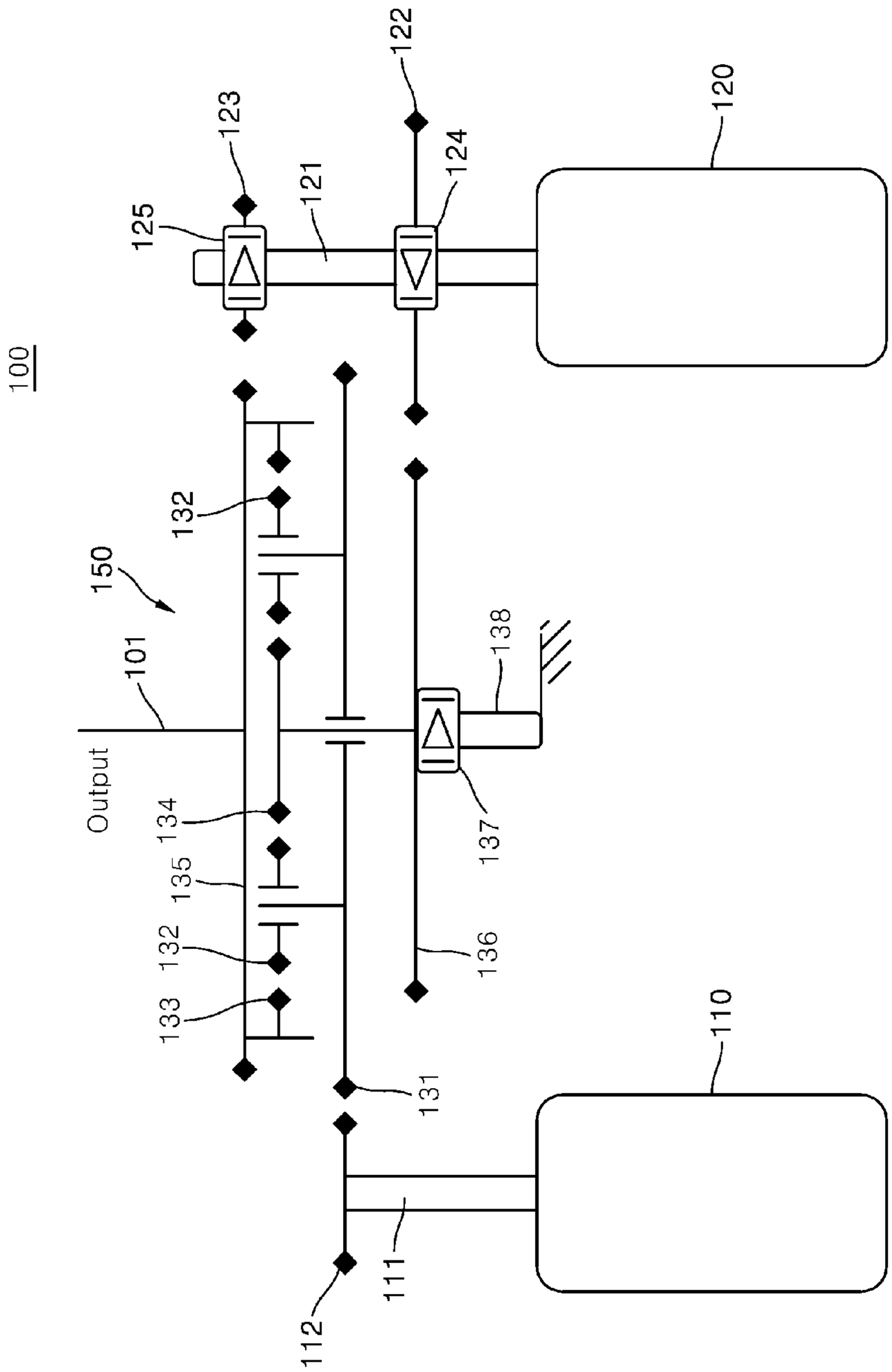
100
Output
101
110
111
112
120
121
122
123
124
125
131
132
133
134
135
136
137
138
150

FIG. 5

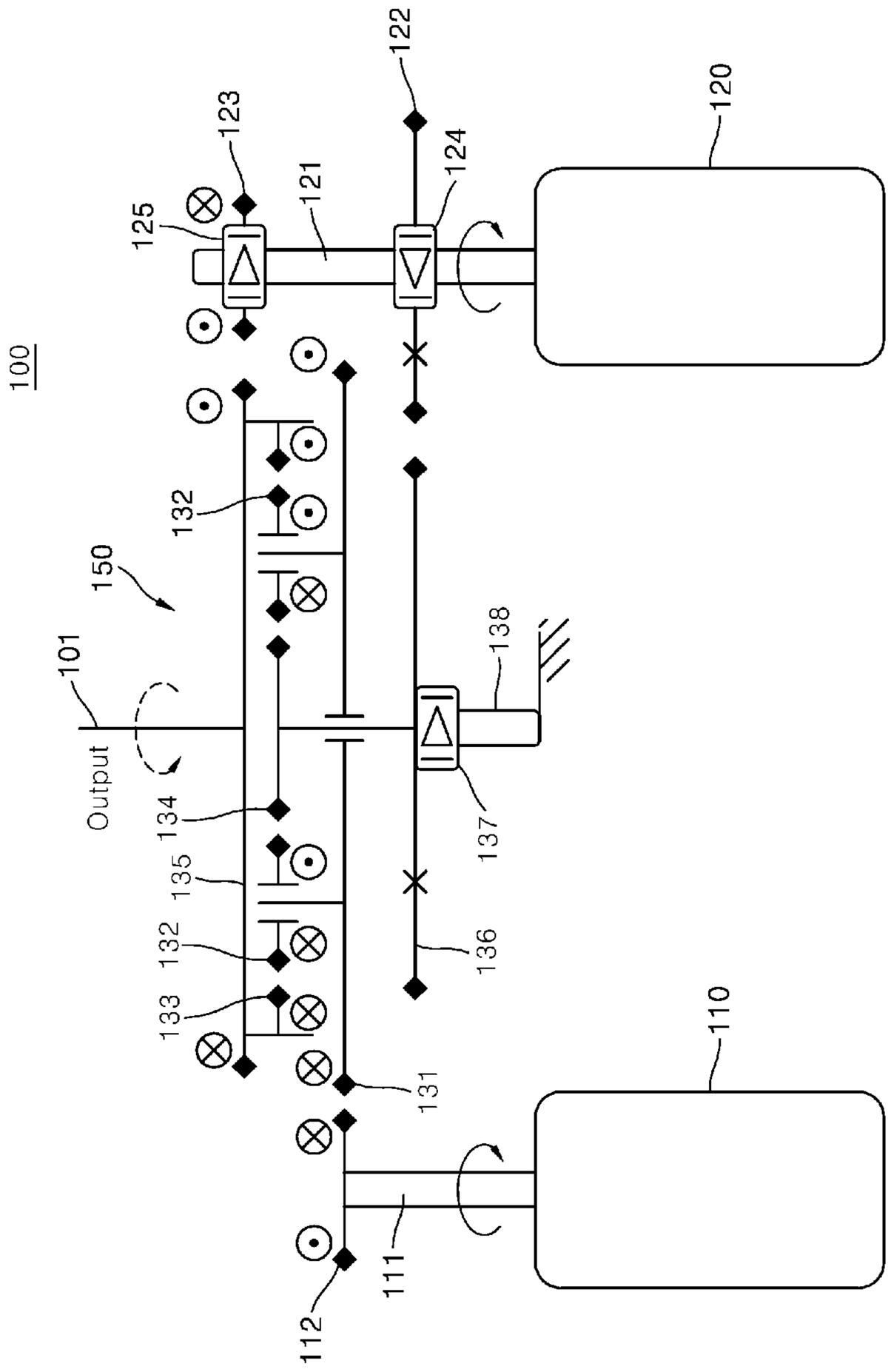
100
101
Output
110
111
112
120
121
122
123
124
125
131
132
133
134
135
136
137
138
150

FIG. 6

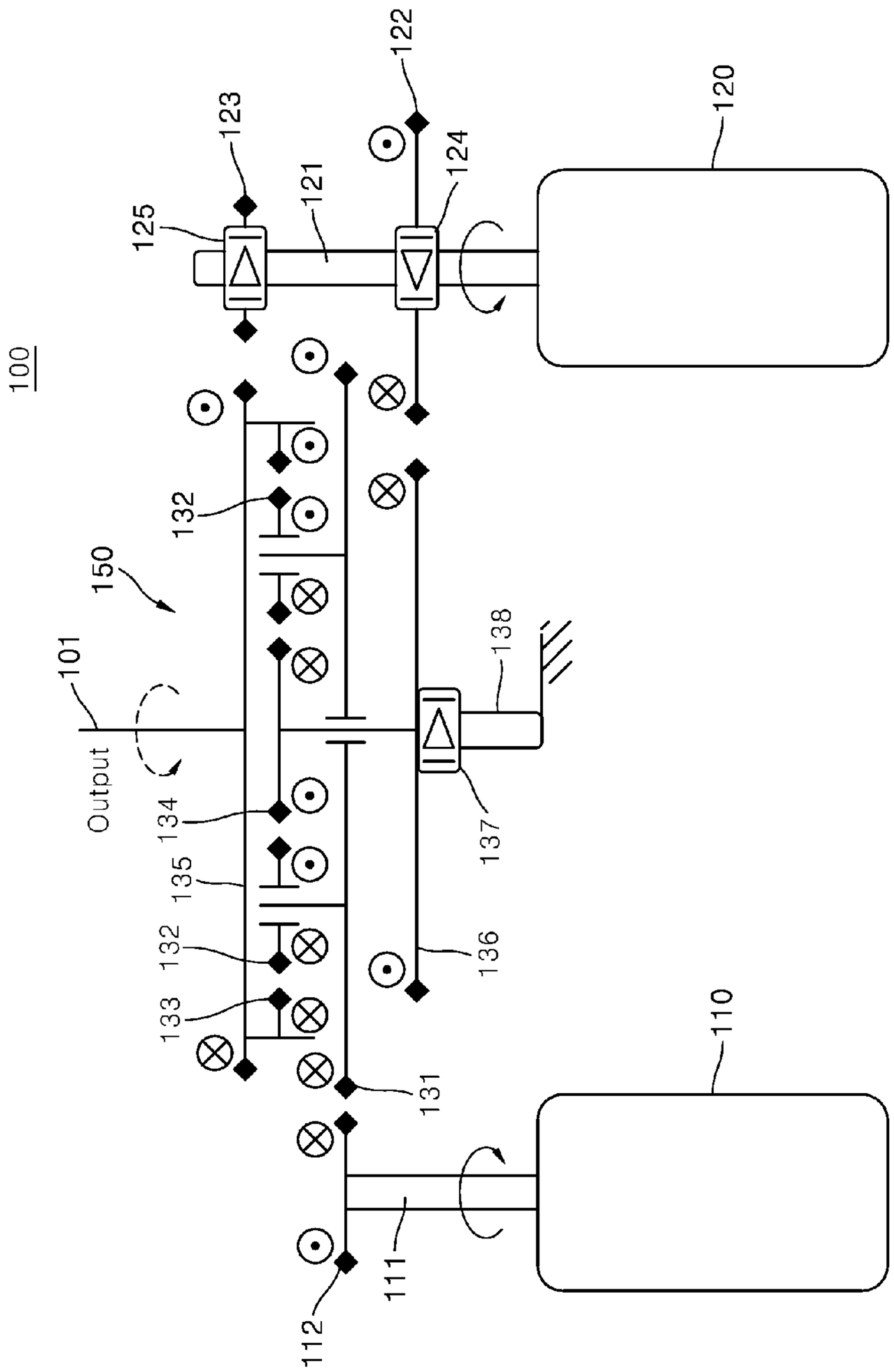
100
101
Output
110
111
112
120
121
122
123
124
125
131
132
133
134
135
136
137
138
150

FIG. 7

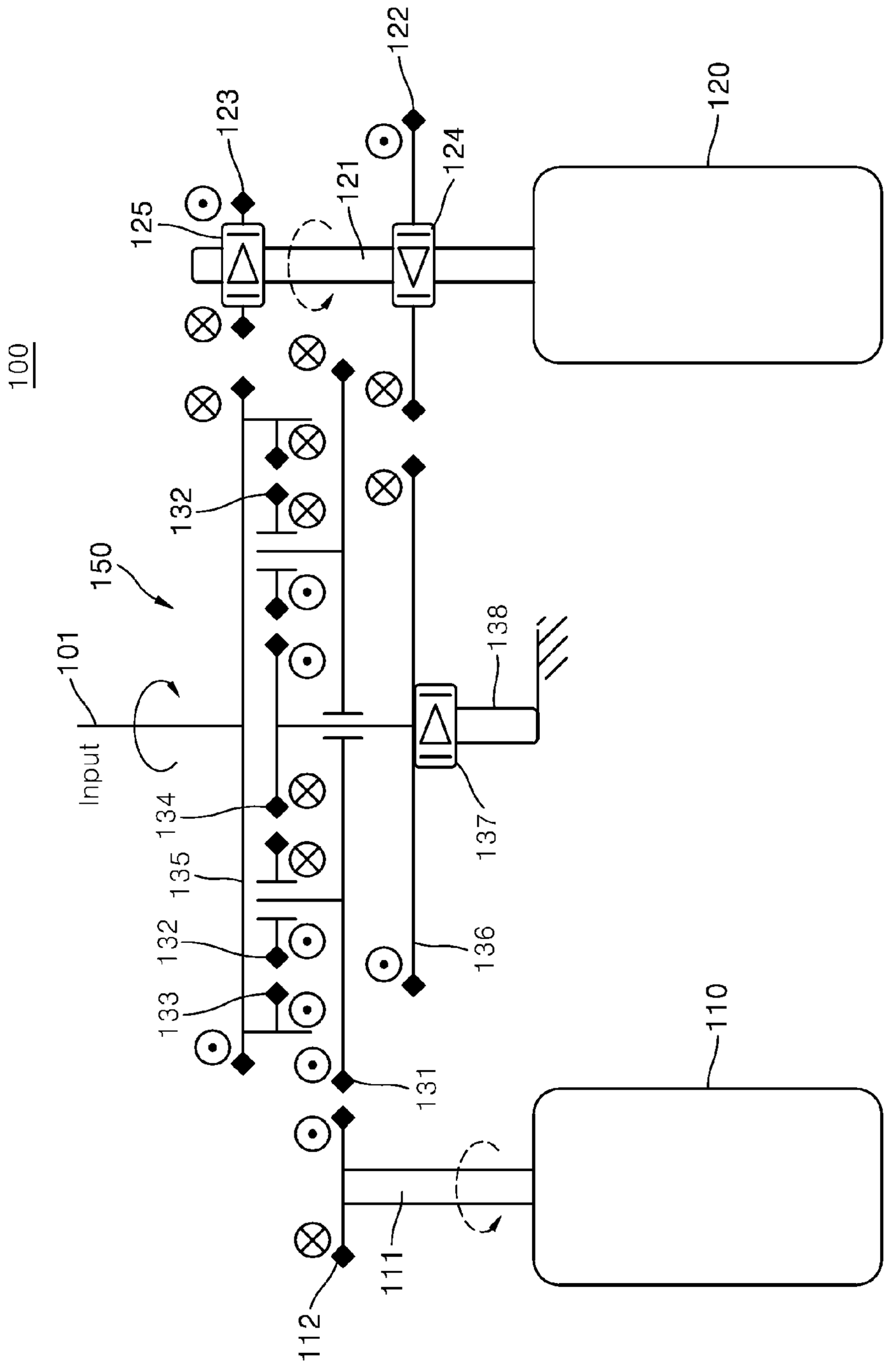
100
101
Input
110
111
112
120
121
122
123
124
125
131
132
133
134
135
136
137
138
150

FIG. 8

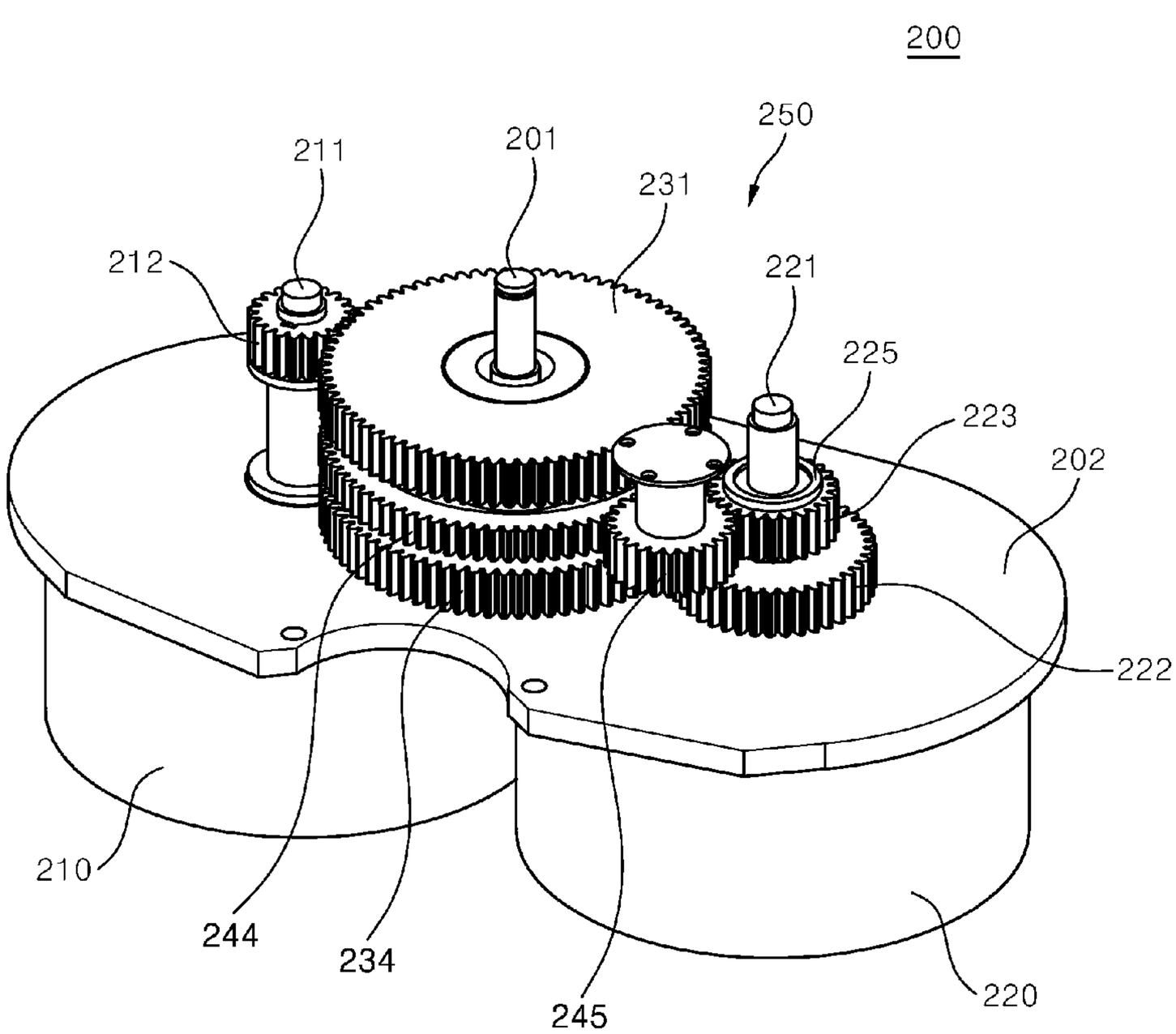

FIG. 9

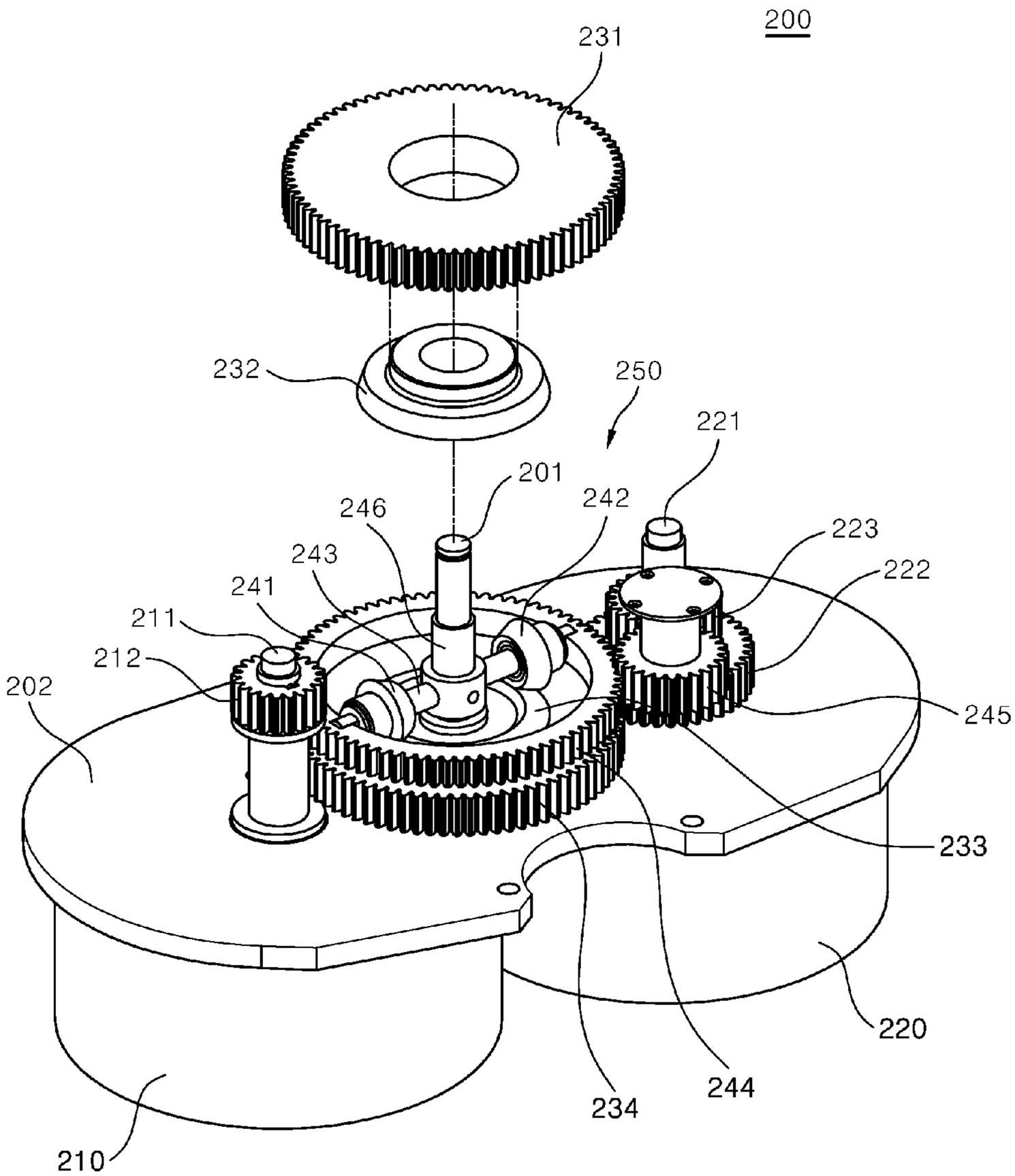
200
231
232
250
221
201
242
246
223
243
222
241
211
212
245
202
233
220
234
244
210

FIG. 10

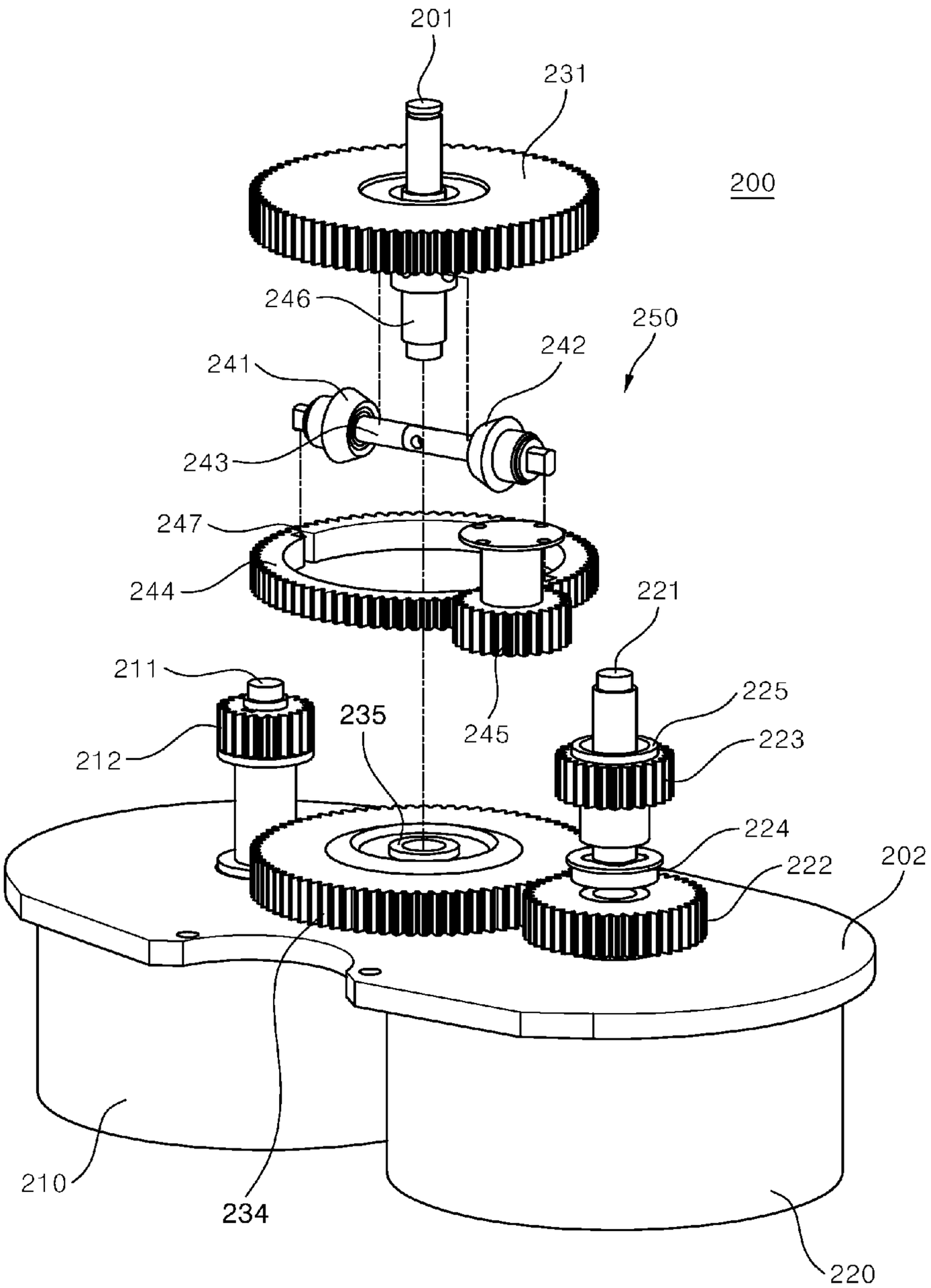
201
231
200
246
250
242
241
243
247
244
221
211
225
235
245
223
212
224
222
202
210
234
220

FIG. 11

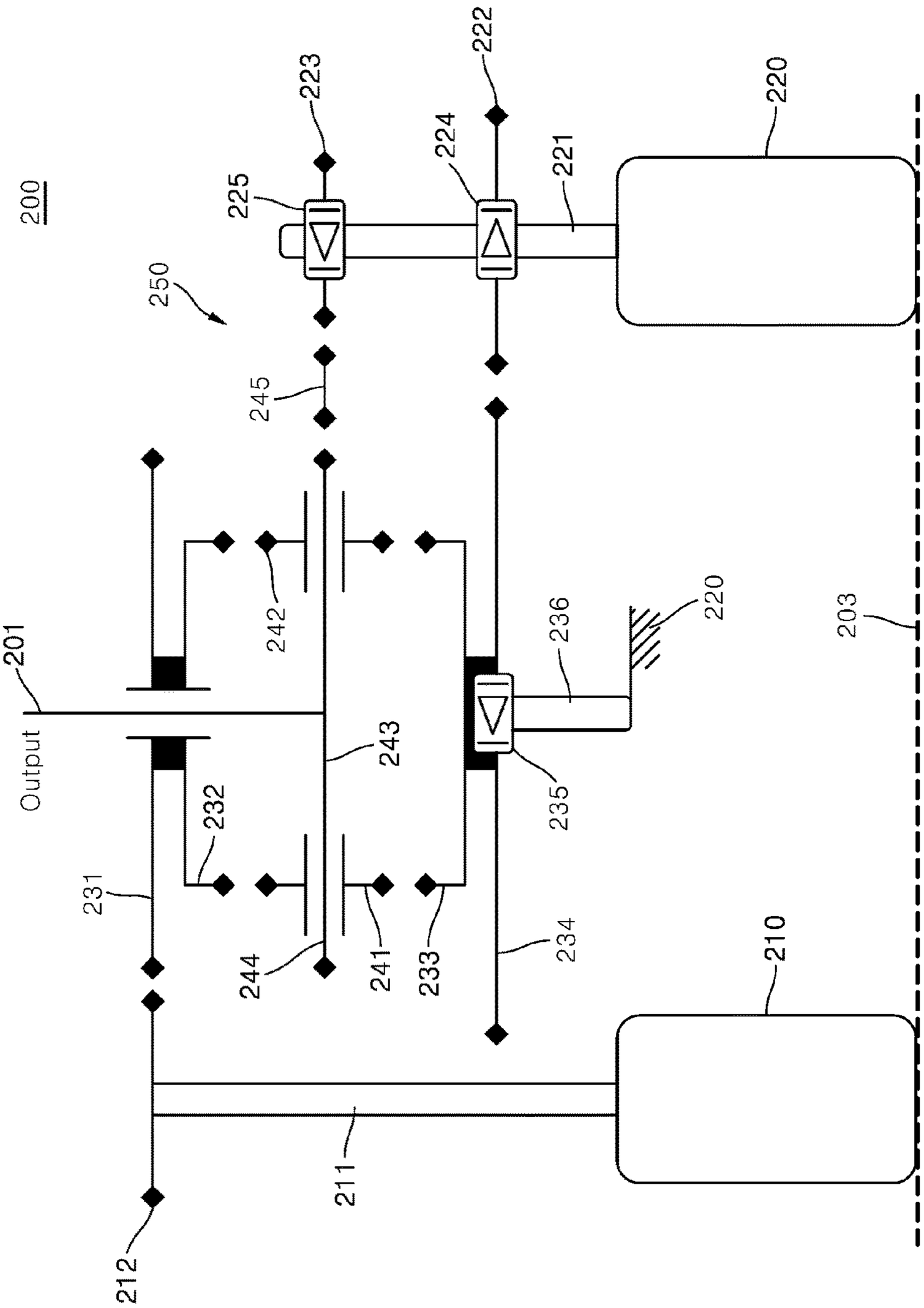
200
250
223
222
220
225
224
221
245
242
201
Output
243
236
220
232
231
235
203
244
241
233
234
210
211
212

FIG. 12

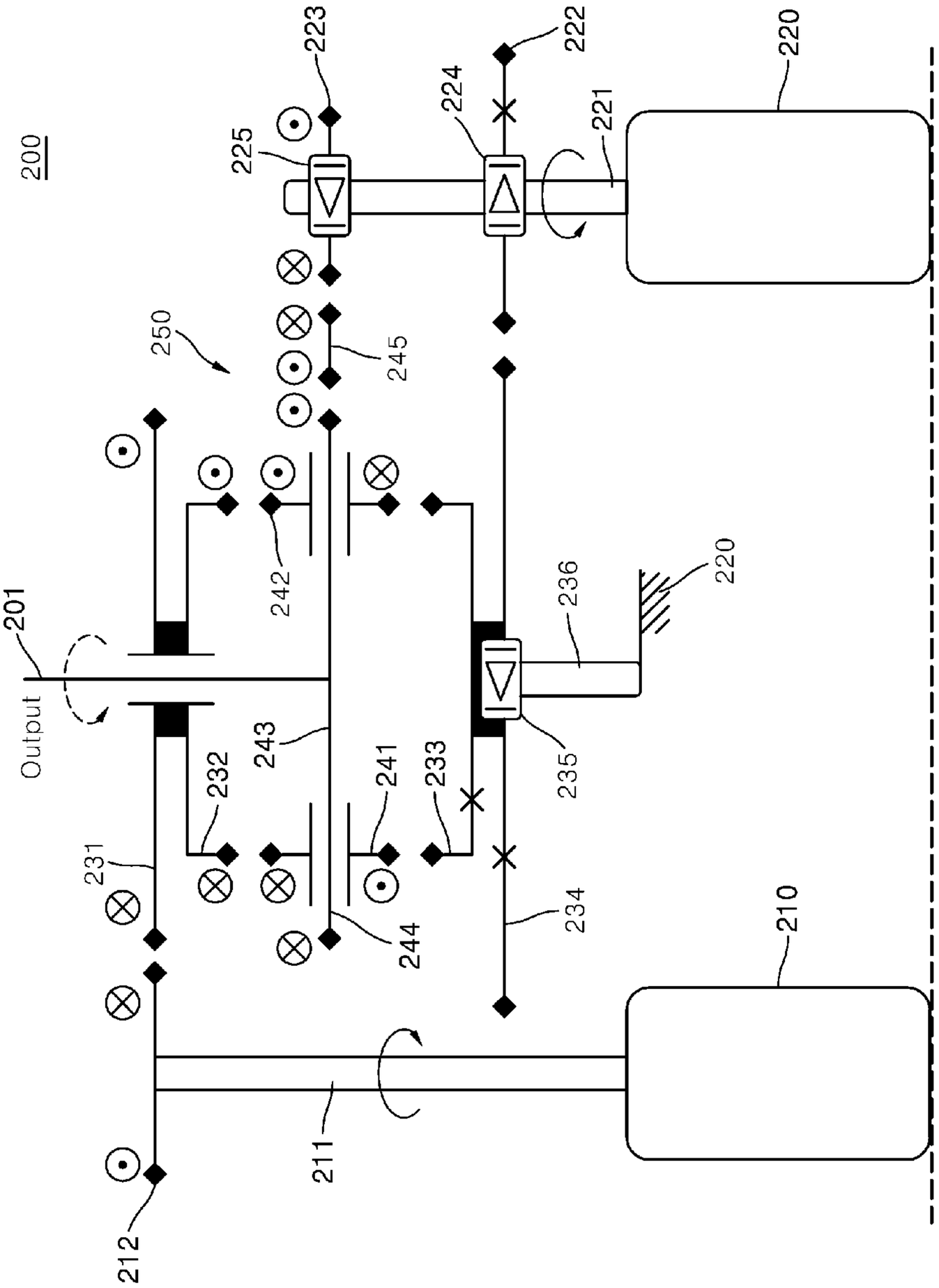
200
223
222
220
224
221
225
250
245
242
201
Output
232
243
241
233
236
220
231
235
234
244
210
211
212

FIG. 13

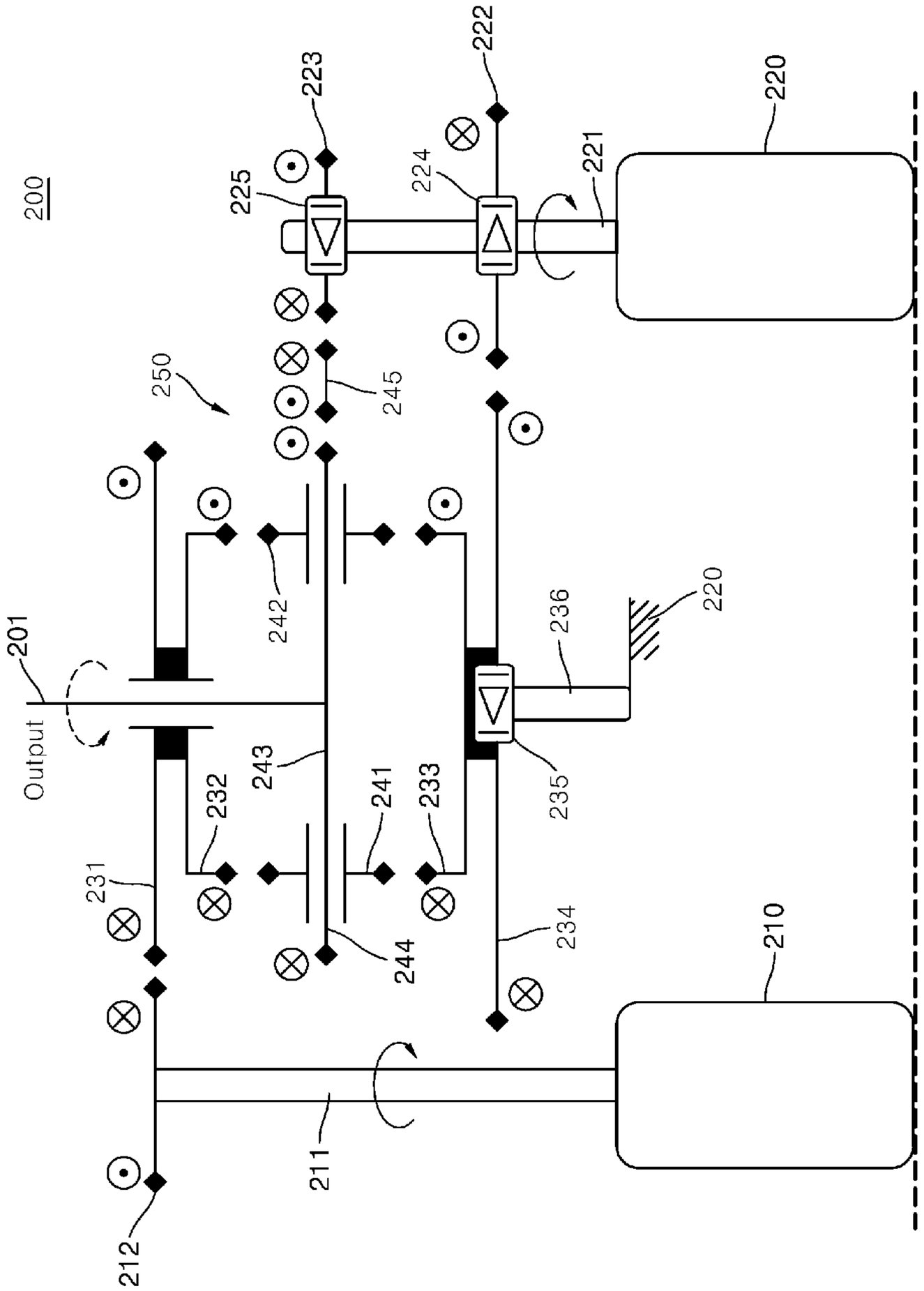
200
201
210
211
212
220
221
222
223
224
225
231
232
233
234
235
236
241
242
243
244
245
250
Output

FIG. 14

INPUT SYNTHESIS APPARATUS

TECHNICAL FIELD

The present invention relates to an input synthesis apparatus, and more particularly, to an input synthesis apparatus capable of creating an output by selectively summing up and synthesizing torque or speeds of inputs.

BACKGROUND ART

In general robot, a power source such as a motor or an engine is used to control a vehicle, a transporting apparatus, or a machine system, and in this case, a capacity of the power source, which satisfies required work (operation, activation), needs to be selected to perform the required work. For example, in a case in which the power source is the motor, a capacity of the motor is closely associated with a size, a weight, and costs of the motor.

In a case in which the robot or the machine system needs to be operated with high torque and at a high speed, a power source having a large capacity is required, which causes an increase in size, weight, and costs of the robot or the machine system.

In the case of the automobile, a gear transmission system, which changes a gear ratio during a process of transmitting rotational force of an engine to wheels, is used to obtain both a high-torque output for allowing the automobile to smoothly travel up a slope and a high-speed output for allowing the automobile to travel at a high speed. However, the gear transmission system is difficult to be used for a small-sized driving system because of a problem of complexity of a mechanical configuration, a price, and a weight thereof.

Meanwhile, the applicant has proposed Korean Patent Application Laid-Open No. 10-2012-0028234 that discloses a planetary gear system using two input properties. However, the applicant has merely proposed a technology for synthesizing input speeds as disclosed in the Korean Patent Application. Therefore, there is a need for an input synthesis apparatus capable of synthesizing torque of inputs as well as the speeds of the inputs in order to create outputs having more various properties.

Therefore, the present invention provides an input synthesis apparatus capable of being simply applied to a small-sized driving system and creating various outputs by selectively synthesizing a speed and torque of the input.

DISCLOSURE

Technical Problem

The present invention has been made in an effort to solve the aforementioned problems, and to provide an input synthesis apparatus capable of creating various outputs by synthesizing a plurality of inputs having different or the same properties.

The present invention provides an input synthesis apparatus capable of creating various outputs by selectively synthesizing torque and speeds of inputs.

The present invention provides an input synthesis apparatus capable of synthesizing speeds or torque of inputs by changing rotation directions of the inputs during an operation of a driving source for creating the inputs.

Technical Solution

In order to solve the aforementioned problems, the present invention provides an input synthesis apparatus including: a first input unit which provides first rotational force; a second input unit which provides second rotational force equal to or different from the first rotational force; a gear unit which is engaged with the first input unit and the second input unit and synthesizes the first rotational force and the second rotational force; and an output unit which outputs resultant force of the first rotational force and the second rotational force, in which the gear unit sums up speeds or torque of the first rotational force and the second rotational force based on whether a rotation direction of the first input unit and a rotation direction of the second input unit are identical to each other.

Gears, which are engaged with the gear unit, may be formed on the first input unit and the second input unit, respectively, and the number of gears formed on the first input unit and the number of gears formed on the second input unit may be different from each other.

Two gears, which are engaged with the gear unit, may be formed on one of the first input unit and the second input unit, and a first one-way bearing and a second one-way bearing may be formed in the two gears.

A power transmission blocking direction of the first one-way bearing and a power transmission blocking direction of the second one-way bearing may be opposite to each other.

The gear unit may include a third one-way bearing formed on a stationary shaft that does not rotate.

A power transmission blocking direction of the third one-way bearing may be identical to a power transmission blocking direction of one of the first one-way bearing and the second one-way bearing.

A gear, which is formed with one of the first one-way bearing and the second one-way bearing which has the same power transmission blocking direction as the third one-way bearing, may be engaged with a planetary gear unit or a differential gear unit of the gear unit.

A gear, which is formed with one of the first one-way bearing and the second one-way bearing which is different in power transmission blocking direction from the third one-way bearing, may be engaged with a gear formed with the third one-way bearing.

The gear unit may include a first input gear which is formed on the first input unit, and a second input gear and a third input gear which are formed on the second input unit, and the planetary gear unit or the differential gear unit may be formed to be engaged with the first input gear, and engaged with the second input gear or the third input gear.

The first one-way bearing and the second one-way bearing may be formed in the second input gear and the third input gear, respectively.

The planetary gear unit may include: a first intermediate gear which is engaged with the first input gear; planet gears which are formed on the first intermediate gear and revolve in a rotation direction of the first intermediate gear; a sun gear which is formed between the planet gears and rotates in a direction opposite to a rotation direction of the planet gears; a ring gear which is engaged with the planet gears and rotates in a direction identical to the rotation direction of the planet gears; a second intermediate gear which has the ring gear formed therein, rotates in the same direction as the ring gear, and is connected to the output unit; and a third intermediate gear which is connected with the sun gear through the same rotating shaft, the third intermediate gear may be engaged with the second input gear, and the second intermediate gear may be engaged with the third input gear.

The differential gear unit may include: a first intermediate gear which is engaged with the first input gear; a first bevel

gear which is formed on a planar portion of the first intermediate gear; idle gears which are engaged with the first bevel gear; a second intermediate gear to which a rotating shaft on which the idle gears are rotatably formed is connected and which rotates in a direction identical to a revolution direction of the idle gears; a second bevel gear which is engaged with the idle gears and formed to face the first bevel gear; and a third intermediate gear which has a planar portion on which the second bevel gear is formed, the output unit is connected to the rotating shaft on which the idle gears are formed, the third intermediate gear may be engaged with the second input gear, and the second intermediate gear may be engaged with the third input gear.

A fourth intermediate gear may be formed to be engaged between the second intermediate gear and the third input gear.

The third one-way bearing may be formed in the third intermediate gear.

Advantageous Effects

As described above, the input synthesis apparatus according to the present invention outputs resultant force of inputs having the same or different properties and selectively synthesizes torque and speeds of the inputs, thereby creating various outputs.

The input synthesis apparatus according to the present invention may selectively synthesize torque or speeds of the inputs, and as a result, it is possible to provide outputs having various speeds or torque as necessary, and thus to obtain an effect of changing a gear ratio.

The input synthesis apparatus according to the present invention may produce high-speed and low-torque or low-speed and high-torque outputs as necessary by separately synthesizing torque and speeds of the inputs, and as a result, it is possible to freely change output properties even in the case of a small-sized driving system such as a small-sized robot. In addition, the input synthesis apparatus may be effectively adopted to a small-sized system, and may be easily modularized to enable a reduction in costs and mass production.

The input synthesis apparatus according to the present invention may increase a maximum speed and maximum torque in comparison with a size or a weight of a usage power source, and may drive the power source by using various methods in accordance with loads of an output shaft, thereby improving energy efficiency.

DESCRIPTION OF DRAWINGS

FIGS. **1** and **2** are views for explaining a concept of an input synthesis apparatus according to the present invention.

FIG. **3** is a perspective view illustrating an input synthesis apparatus according to one exemplary embodiment of the present invention.

FIG. **4** is an exploded perspective view of the input synthesis apparatus according to FIG. **3**.

FIGS. **5** to **8** are views for explaining a relationship between an input and an output of the input synthesis apparatus according to FIG. **3**.

FIG. **9** is a perspective view illustrating an input synthesis apparatus according to another exemplary embodiment of the present invention.

FIGS. **10** and **11** are exploded perspective views of the input synthesis apparatus according to FIG. **9**.

FIGS. **12** to **14** are views for explaining a relationship between an input and an output of the input synthesis apparatus according to FIG. **9**.

BEST MODE

Hereinafter, exemplary embodiments according to the present invention will be described in detail with reference to the accompanying drawings. However, the present invention is not restricted or limited by the exemplary embodiments. Like reference numerals indicated in the respective drawings refer to the same constituent elements.

FIGS. **1** and **2** are views for explaining a concept of an input synthesis apparatus according to the present invention, FIG. **3** is a perspective view illustrating an input synthesis apparatus according to one exemplary embodiment of the present invention, FIG. **4** is an exploded perspective view of the input synthesis apparatus according to FIG. **3**, FIGS. **5** to **8** are views for explaining a relationship between an input and an output of the input synthesis apparatus according to FIG. **3**, FIG. **9** is a perspective view illustrating an input synthesis apparatus according to another exemplary embodiment of the present invention, FIGS. **10** and **11** are exploded perspective views of the input synthesis apparatus according to FIG. **9**, and FIGS. **12** to **14** are views for explaining a relationship between an input and an output of the input synthesis apparatus according to FIG. **9**.

Referring to FIGS. **1** and **2**, input synthesis apparatuses **100** and **200** according to the present invention may synthesize two inputs having the same capacity (or property) as illustrated in FIG. **1**, and may synthesize the two inputs by dividing the two inputs into torque and speed. The result of the synthesis is shown in FIG. **2**. By synthesizing the inputs by dividing the inputs into the torque and the speed, it is possible to create both a low-speed and high-torque output and a high-speed and low-torque output as illustrated in FIG. **2**. The low-speed and high-torque output is an output created by synthesizing torque of two types of inputs, and as for the torque, a maximum value is a value produced by summing up the torque of the two inputs, and as for the speed, an output having a speed equal to a speed of the two inputs may be created. In a case in which a hybrid automobile or the like provided with two driving sources begins to be driven, the torque synthesis may be required. In addition, the torque synthesis is also required when the automobile travels up a slope.

Meanwhile, the high-speed and low-torque output is an output created by synthesizing speeds of two types of inputs, and as for the speed, a maximum value is a value produced by summing up the speeds of the two inputs, and as for the torque, an output having torque equal to the torque of the two inputs. When the hybrid automobile or the like described above exhibits a highest speed, the speed synthesis may be required.

Hereinafter, the input synthesis apparatus, which enables the speed synthesis or the torque synthesis, will be described in more detail.

Referring to FIGS. **3** and **9**, the input synthesis apparatus **100** or **200** according to the present invention includes a first input unit **110** or **210** which provides first rotational force; a second input unit **120** or **220** which provides second rotational force equal to or different from the first rotational force; a gear unit **150** or **250** which is engaged with the first input unit **110** or **210** and the second input unit **120** or **220** and synthesizes the first rotational force and the second rotational force; and an output unit **101** or **201** which outputs resultant force of the first rotational force and the second

rotational force, in which the gear unit **150** or **250** may sum up the speed or the torque of the first rotational force and the second rotational force in accordance with whether a rotation direction of the first input unit **110** or **210** and a rotation direction of the second input unit **120** or **220** are identical to each other.

With the configuration as described above, the input synthesis apparatus **100** or **200** according to the present invention may synthesize only the speeds of the inputs or may synthesize only the torque of the inputs, and the input synthesis apparatus **100** or **200** may synthesize the torque or the speed during the operations of the first input unit **110** or **210** and the second input unit **120** or **220**, thereby producing outputs having various properties.

Meanwhile, the first input unit **110** or **210** and the second input unit **120** or **220** have gears which are engaged with the gear unit **150** or **250**, respectively, and the number of gears formed on the first input unit **110** or **210** may be different from the number of gears formed on the second input unit **120** or **220**.

Referring to FIGS. **3** and **9**, in the input synthesis apparatus **100** or **200** according to the present invention, the first input unit **110** or **210** may have a single gear **112** or **212**, and the second input unit **120** or **220** may have two gears **122** and **123**, or **222** and **223**.

The input synthesis apparatus **100** or **200** according to the present invention includes two input units **110** and **120**, or **210** and **220**, and as the input unit, various power sources such as an electric motor, a motor, and an engine may be used. The two input units **110** and **120**, or **210** and **220** may be fixed to a support plate **102** or **202**, and rotational force of the first and second input units **110** and **120**, or **210** and **220** may be transmitted through power shafts **111** and **121**, or **211** and **221**, respectively.

The first input gear **112** or **212** may be formed on the power shaft **111** or **211** of the first input unit **110** or **210**, and the second input gear **122** or **222** and the third input gear **123** or **223** may be formed on the power shaft **121** or **221** of the second input unit **120** or **220**. That is, different numbers of gears may be mounted or formed on the two input units. In the case of the input synthesis apparatus **100** or **200** according to the present invention, a single gear is formed on the first input unit **110** or **210**, and two gears are formed on the second input unit **120** or **220**.

The first to third input gears **112**, **122**, and **123**, or **212**, **222**, and **223** are engaged with the gear unit **150** or **250** and may synthesize the speed or the torque of the inputs. Here, the gear unit **150** or **250** may include first to third input gears **112**, **122**, and **123**, or **212**, **222**, and **223**. Hereinafter, a description will be made to an example in which the first to third input gears **112**, **122**, and **123**, or **212**, **222**, and **223** are included in the gear unit **150** or **250**.

As described above, the two gears **122** and **123**, or **222** and **223**, which are engaged with the gear unit, may be formed on at least one of the first input unit **110** or **210** and the second input unit **120** or **220**, and a first one-way bearing **124** or **224** and a second one-way bearing **125** or **225** may be formed in the two gears **122** and **123**, or **222** and **223**, respectively. That is, the first one-way bearing **124** or **224** and the second one-way bearing **125** or **225** may be formed in the second input gear **122** or **222** and the third input gear **123** or **223** mounted on the power shaft **121** or **221** of the second input unit **120** or **220**, respectively.

The one-way bearing is also called a clutch bearing, and the one-way bearing is a member that transmits rotational force and power in any one direction, but does not transmit power in the other direction. Referring to FIGS. **5** and **12**, rotation directions of the first one-way bearing **124** or **224** and the second one-way bearing **125** or **225** are illustrated.

A power transmission blocking direction of the first one-way bearing **124** or **224** and a power transmission blocking direction of the second one-way bearing **125** or **225** may be opposite to each other.

Meanwhile, the gear unit **150** or **250** may include a third one-way bearing **137** or **235** which is formed on a stationary shaft **138** or **236** that does not rotate. The third one-way bearing **137** or **235** may control a direction in which the gears of the gear unit **150** or **250** in which the third one-way bearing **137** or **235** is installed are rotated.

A power transmission blocking direction of the third one-way bearing **137** or **235** may be identical to the power transmission blocking direction of any one of the first one-way bearing **124** or **224** and the second one-way bearing **125** or **225**. Referring to FIGS. **5** and **12**, in the input synthesis apparatus **100** or **200** according to the present invention, the power transmission blocking direction of the third one-way bearing **137** or **235** and the power transmission blocking direction of the second one-way bearing **125** or **225** are identical to each other, but different from the power transmission blocking direction of the first one-way bearing **124** or **224**.

The gear **123** or **223**, which is formed with one of the first one-way bearing **124** or **224** and the second one-way bearing **125** or **225** which has the same power transmission blocking direction as the third one-way bearing **137** or **235**, may be formed to be engaged with a planetary gear unit or a differential gear unit of the gear unit **150** or **250**. Here, the planetary gear unit or the differential gear unit may be a unit that synthesizes, together with the one-way bearing, the torque or the speed of the inputs.

The gear **122** or **222**, which is formed with one (**124** or **224**) of the first one-way bearing **124** or **224** and the second one-way bearing **125** or **225** which is different in power transmission blocking direction from the third one-way bearing **137** or **235**, may be formed to be engaged with a gear **136** or **234** formed with the third one-way bearing **137** or **235**.

The gear unit **150** or **250** includes the first input gear **112** or **212** formed on the first input unit **110** or **210**, and the second input gear **122** or **222** and the third input gear **123** or **223** formed on the second input unit **120** or **220**, and the planetary gear unit or the differential gear unit may be formed to be engaged with the first input gear **112** or **212** and engaged with the second input gear **122** or **222** or the third input gear **123** or **223**.

In the input synthesis apparatus **100** according to one exemplary embodiment of the present invention as illustrated in FIGS. **3** to **8**, the gear unit **150** includes the planetary gear unit, and in the input synthesis apparatus **200** according to another exemplary embodiment of the present invention as illustrated in FIGS. **9** to **14**, the gear unit **250** includes the differential gear unit.

Referring to FIGS. **3** to **8**, the planetary gear unit, which is included in the gear unit **150** of the input synthesis apparatus **100** according to one exemplary embodiment of the present invention, may include a first intermediate gear **131** which is engaged with the first input gear **112**; planet gears **132** which are formed on the first intermediate gear **131** and revolve in the rotation direction of the first intermediate gear **131**, a sun gear **134** which is formed between the planet gears **132** and rotates in a direction opposite to the rotation direction of the planet gear **132**; a ring gear **133** which is engaged with the planet gears **132** and rotates in a direction identical to the rotation direction of the planet

gears **132**; a second intermediate gear **135** which has the ring gear **133** formed therein so as to rotate in the same direction as the ring gear **133** and connects with the output unit **101**; and a third intermediate gear **136** which is connected with the sun gear **134** through the same rotating shaft.

Here, the third intermediate gear **136** may be engaged with the second input gear **122**, and the second intermediate gear **135** may be engaged with the third input gear **123**.

Referring to FIGS. **3** and **4**, the ring gear **133** and the second intermediate gear **135** are formed to rotate together. For example, as illustrated in, the second intermediate gear **135** may be coupled to the ring gear **133** in such a manner that the second intermediate gear **135** is fitted with an outer circumferential surface of the ring gear **133**. Gear teeth may be formed on an outer circumferential surface of the second intermediate gear **135**.

The first intermediate gear **131** is a carrier. Because rotating shafts of the planet gears **132** are fixedly installed on a planar portion of the first intermediate gear **131**, the revolution direction of the planet gears **132** is coincident with the rotation direction of the first intermediate gear **131**.

An output shaft or the output unit **101** is formed to rotate together with the second intermediate gear **135**. To this end, a circular plate (not illustrated) may be fixedly fastened to a planar portion of the second intermediate gear **135**, and the output unit **101** may be coupled to a center of the circular plate.

The first one-way bearing **124** may be mounted between the second input gear **122** and the power shaft **121**, and the second one-way bearing **125** may be mounted between the third input gear **123** and the power shaft **121**. In addition, the third one-way bearing **137** may be mounted between the third intermediate gear **136** and the stationary shaft **138**.

A principle in which the torque and the speed of the inputs are synthesized by the input synthesis apparatus **100** according to one exemplary embodiment of the present invention will be described with reference to FIGS. **6** to **8**. In FIGS. **6** to **8**, the symbol "⊙" means that the gear protrudes from a plane, and the symbol "X in a circle ○" means that the gear enters the plane. That is, the symbols mean the rotational direction of the gear.

FIG. **6** illustrates a principle of synthesizing the torque of the inputs. That is, FIG. **6** illustrates a power transmission process in a case in which the torque of the first rotational force provided by the first input unit **110** and the torque of the second rotational force provided by the second input unit **120** are synthesized. First, in a case in which the rotation direction of the first rotational force created by the first input unit **110** and the rotation direction of the second rotational force created by the second input unit **120** are identical to each other, the torque may be synthesized (see a solid line arrow in FIG. **6**).

As the power shaft **111** of the first input unit **110** rotates, the first input gear **112** rotates, and the first intermediate gear **131** engaged with the first input gear **112** rotates. The first rotational force of the first input unit **110** may be transmitted to the first intermediate gear **131**. When the first intermediate gear **131** rotates, the planet gears **132**, which are mounted on the planar portion of the first intermediate gear **131**, revolve while rotating. With the revolution of the planet gears **132**, the ring gear **133** rotates, and in this case, the ring gear **133** rotates in a direction identical to the revolution direction of the planet gears **132**. When the ring gear **133** rotates, the second intermediate gear **135** rotates in a direction identical to the rotation direction of the ring gear **133**, and the output unit **101** connected to the second intermediate gear **135** also rotates. Through these processes, the first rotational force of the first input unit **110** is transmitted to the output unit **101**.

In addition, as the planet gears **132** rotate, the sun gear **134** engaged with the planet gears **132** is about to rotate, and in this case, the sun gear **134** is about to rotate in a direction identical to the rotation direction of the ring gear **133**. In this case, the third intermediate gear **136** connected with the sun gear **134** is about to rotated, but the third intermediate gear **136** cannot rotate because of the third one-way bearing **137**, and only the ring gear **133** rotates.

Meanwhile, as the power shaft **121** of the second input unit **120** rotates, the second input gear **122** and the third input gear **123** need to rotate, but the second input gear **122** does not rotate because of the first one-way bearing **124**, and only the third input gear **123** rotates. The second one-way bearing **125** transmits rotational force or driving power of the second input unit **120** to the third input gear **123**.

The third input gear **123** is engaged with the second intermediate gear **135**, and the second rotational force is transmitted to the second intermediate gear **135**, and transmitted finally to the output unit **101**. In a case in which the first input unit **110** and the second input unit **120** rotate in the same direction as described above, that is, in a case in which the rotation directions of the first rotational force and the second rotational force are identical to each other, the first rotational force and the second rotational force are transmitted directly to the second intermediate gear **135** by the planetary gear unit and the one-way bearings, and as a result, the torque of the first rotational force and the second rotational force may be synthesized and created through the output unit **101**.

FIG. **7** illustrates a principle of synthesizing the speeds of the inputs. That is, FIG. **7** illustrates a power transmission process in a case in which the speed of the first rotational force provided by the first input unit **110** and the speed of the second rotational force provided by the second input unit **120** are synthesized. First, in a case in which the rotation direction of the first rotational force created by the first input unit **110** and the rotation direction of the second rotational force created by the second input unit **120** are different from each other, the speed may be synthesized (see a solid line arrow in FIG. **7**).

The process in which the first rotational force of the first input unit **110** is transmitted finally to the output unit **101** through the second intermediate gear **135** is the same as the process in FIG. **6**.

Meanwhile, as the power shaft **121** of the second input unit **120** rotates, the second input gear **122** and the third input gear **123** need to rotate, and the second input gear **122** rotates by the first one-way bearing **124**, but the third input gear **123** idles because of the second one-way bearing **125**. That is, even though the third input gear **123** rotates, the third input gear **123** does not transmit rotational force to the second intermediate gear **135**.

The second input gear **122** is engaged with the third intermediate gear **136** and transmits rotational force to the third intermediate gear **136**, and the third intermediate gear **136** transmits rotational force to the sun gear **134** connected with the third intermediate gear **136**. In this case, the rotation direction of the rotational force being transmitted to the sun gear **134** by the third intermediate gear **136** and the rotation direction of the rotational force being transmitted to the sun gear **134** by the first input gear **112** are identical to each other. For this reason, a rotational speed of the second intermediate gear **135** is increased, and finally, the speed of

the first rotational force and the speed of the second rotational force may be synthesized and created through the output unit **101**.

FIG. **8** illustrates a power transmission relationship in a case in which the output unit **101** receives an input. Assuming that the input synthesis apparatus **100** according to one exemplary embodiment of the present invention is connected with a pedal of a bicycle and the output unit **101** is connected with a wheel of the bicycle, a power transmission process when moving the bicycle backward is identical to a process illustrated in FIG. **8**.

When the output unit **101** rotates counterclockwise, the second intermediate gear **135** connected with the output unit **101** also rotates in the same direction, and rotational force may be sequentially transmitted to the power shaft **111** of the first input unit **110** and the power shaft **121** of the second input unit **120** by the planetary gear unit. In this process, the power shafts **111** and **121** rotate in the same direction by the operations of the planetary gear unit and the one-way bearings **124**, **125**, and **137**. In this case, the power shafts **111** and **121** idle.

Meanwhile, referring to FIGS. **9** to **14**, the differential gear unit included in the gear unit **250** of the input synthesis apparatus **200** according to another exemplary embodiment of the present invention may include a first intermediate gear **231** which is engaged with the first input gear **212**; a first bevel gear **232** which is formed on a planar portion of the first intermediate gear **231**; idle gears **241** and **242** which are engaged with the first bevel gear **232**; a second intermediate gear **244** to which a rotating shaft **243** on which the idle gears **241** and **242** are rotatably formed is connected and which rotates in a direction identical to a revolution direction of the idle gears **241** and **242**; a second bevel gear **233** which is engaged with the idle gears **241** and **242** and formed to face the first bevel gear **232**; and a third intermediate gear **234** which has a planar portion on which the second bevel gear **233** is formed.

Here, the output unit **201** is connected to the rotating shaft **243** on which the idle gears **241** and **242** are formed, the third intermediate gear **234** is engaged with the second input gear **222**, and the fourth intermediate gear **245** may be formed to be engaged between the second intermediate gear **244** and the third input gear **223**.

Referring to FIGS. **9** to **11**, the first bevel gear **232** and the first intermediate gear **231** may be integrally formed, and the second bevel gear **233** and the third intermediate gear **234** may be integrally formed. The idle gears **241** and **242** and the second intermediate gear **244** are positioned between the first intermediate gear **231** and the third intermediate gear **234**.

The idle gears **241** and **242** may revolve around a center of the second intermediate gear **244**, and to this end, two idle gears **241** and **242** are rotatably mounted at both ends of the rotating shaft **243**. The both ends of the rotating shaft **243** penetrate the idle gears **241** and **242** and protrude, and the protruding both ends are fitted with grooves **247** formed in an inner circumferential surface of the second intermediate gear **244**, respectively. For this reason, when the second intermediate gear **244** rotates, the rotating shaft **243** also rotates together with the second intermediate gear **244**, and the idle gears **241** and **242** mounted on the rotating shaft **243** revolve in a direction identical to the rotation direction of the second intermediate gear **244**.

Meanwhile, since the idle gears **241** and **242** revolve in a state of being engaged with the first and second bevel gears **232** and **233**, the idle gears **241** and **242** revolve while rotating. Since the rotating shaft **243** rotates because of the revolution of the idle gears **241** and **242**, the output unit **201** connected to the rotating shaft **243** rotates.

The output unit **201** passes through the first intermediate gear **231** and is exposed to the outside, and as a result, rotational force of the first intermediate gear **231** is not transmitted to the output unit **201**.

Meanwhile, the third one-way bearing **235** may be formed on the third intermediate gear **234**. That is, the third one-way bearing **235** is mounted between the third intermediate gear **234** and the stationary shaft **236**. Non-described reference numeral "**203**" in FIG. **12** is a case.

A principle in which the torque and the speed of the inputs are synthesized by the input synthesis apparatus **200** according to another exemplary embodiment of the present invention will be described with reference to FIGS. **13** and **14**.

FIG. **13** illustrates a principle of synthesizing the torque of the inputs. That is, FIG. **13** illustrates a power transmission process in a case in which the torque of the first rotational force provided by the first input unit **210** and the torque of the second rotational force provided by the second input unit **220** are synthesized. First, in a case in which the rotation direction of the first rotational force created by the first input unit **210** and the rotation direction of the second rotational force created by the second input unit **220** are different from each other, that is, in a case in which the first input unit **210** rotates clockwise and the second input unit **220** rotates counterclockwise, the torque may be synthesized (see a solid line arrow in FIG. **13**). That is, in a case in which the second input unit **220** rotates in a reverse direction, the torque may be synthesized.

When the power shaft **211** of the first input unit **210** rotates clockwise, the first input gear **212** creates the first rotational force while rotating in the same direction. The first rotational force is transmitted to the first intermediate gear **231** engaged with the first input gear **212**. When the first intermediate gear **231** rotates, the first bevel gear **232** also rotates in the same direction. With the rotation of the first bevel gear **232**, the idle gears **241** and **242** revolve while rotating. Since the idle gears **241** and **242** rotate, the second bevel gear **233** and the third intermediate gear **234**, which are engaged with the idle gears **241** and **242**, are about to rotate in a direction opposite to the rotation direction of the first bevel gear **232**, but the third one-way bearing **235** inhibits the rotation of the third intermediate gear **234**, and as a result, the second bevel gear **233** also cannot rotate. In a case in which the speed is synthesized, an output is created because the input unit is operated to inhibit the second bevel gear **233** from rotating in a direction opposite to the rotation direction of the first bevel gear **232**, but in a case in which the torque is synthesized, an output is not created at all if the second bevel gear **233** cannot be inhibited from rotating in a direction opposite to the rotation direction of the first bevel gear **232**, and the idle gears **241** and **242** merely rotate and revolve. Therefore, in order to create an output even in a case in which the torque is synthesized, the third one-way bearing **235** is required. That is, in a case in which the torque is synthesized, the rotation of the third intermediate gear **234** is inhibited by the third one-way bearing **235**, and as a result, the second bevel gear **233** does not also rotate.

Meanwhile, since the idle gears **241** and **242** revolve in the same direction as the first intermediate gear **231**, the output unit **201** connected with the rotating shaft **243** also rotates in the same direction (counterclockwise). Through these processes, the first rotational force of the first input unit **210** is transmitted to the output unit **201**.

In addition, when the power shaft **221** of the second input unit **220** rotates counterclockwise, the second input gear **222**

does not rotate, and only the third input gear **223** rotates in the same counterclockwise. The rotational force of the second input gear **222** is transmitted to the second intermediate gear **244** via the fourth intermediate gear **245**. That is, the torque of the second intermediate gear **244**, which is created by the first input unit **210**, and the torque of the second intermediate gear **244**, which is created by the second input unit **220**, are summed up. The torque of the second intermediate gear **244**, which has been summed up, is transmitted to the output shaft **201** through the rotating shaft **243**. The torque of the first input unit **210** and the torque of the second input unit **220** are synthesized in accordance with the aforementioned principle.

FIG. **14** illustrates a principle of synthesizing the speeds of the inputs. That is, FIG. **14** illustrates a power transmission process in a case in which the speed of the first rotational force provided by the first input unit **210** and the speed of the second rotational force provided by the second input unit **220** are synthesized. First, in a case in which the rotation direction of the first rotational force created by the first input unit **210** and the rotation direction of the second rotational force created by the second input unit **220** are identical to each other (the clockwise direction in FIG. **14**), the speed may be synthesized. That is, the speed may be synthesized when the second input unit **220** rotates in a direction (clockwise) identical to the rotation direction of the first input unit **210** (see a solid line arrow in FIG. **14**).

The process in which the first rotational force of the first input unit **210** is transmitted finally to the output unit **201** through the second intermediate gear **244** is the same as the process in FIG. **13**.

Meanwhile, as the power shaft **221** of the second input unit **220** rotates clockwise, the second input gear **222** and the third input gear **223** need to rotate, and the second input gear **222** rotates by the first one-way bearing **224**, but the third input gear **223** idles because of the second one-way bearing **225**. That is, even though the third input gear **223** rotates, the third input gear **223** does not transmit rotational force to the second intermediate gear **244**.

The second input gear **222** is engaged with the third intermediate gear **234** and transmits rotational force to the third intermediate gear **234**, the third intermediate gear **234** allows the idle gears **241** and **242** to idle through the second bevel gear **233**, and transmits rotational force to the output unit **201** connected to the rotating shaft **243**. In this case, in a case in which the speed of the first bevel gear **232** and the speed of the second bevel gear **233**, which have been created by the first input unit **210** and the second input unit **220**, are equal to each other, the idle gears **241** and **242** only revolve without rotating. If the rotational speed of the first bevel gear **232** and the rotational speed of the second bevel gear **233** are different from each other, the idle gears **241** and **242** rotate in a particular direction, and revolve in the same direction as the first bevel gear **232** and the second bevel gear **233**.

Revolution force of the idle gears **241** and **242** rotates the output shaft **201** through the rotating shaft **243**. That is, an idle speed of the idle gears **241** and **242** is a speed of the output shaft **201**. In this case, because the idle speed of the idle gears **241** and **242**, which is caused by the first input unit **210**, and the idle speed of the idle gears **241** and **242**, which is caused by the second input unit **220**, are summed up, the speed of the first input unit **210** and the speed of the second input unit **220** are summed up.

As described above, in a case in which the speeds are synthesized, the first bevel gear **232** and the second bevel gear **233** rotate always in the same direction. In addition, a direction in which the idle gears **241** and **242** rotate is determined based on a difference in speed between the first bevel gear **232** and the second bevel gear **233**.

As described above, in a case in which the three one-way bearings and the planetary gear unit are provided, the input synthesis apparatus **100** according to the present invention synthesizes the torque when the direction of the first rotational force provided by the first input unit and the direction of the second rotational force provided by the second input unit are identical to each other, and synthesizes the speed when the direction of the first rotational force provided by the first input unit and the direction of the second rotational force provided by the second input unit are different from each other, and as a result, it is possible to produce outputs having various speeds and torque.

While the exemplary embodiments of the present invention have been described above with reference to particular contents such as specific constituent elements, the limited exemplary embodiments, and the drawings, but the exemplary embodiments are provided merely for the purpose of helping understand the present invention overall, and the present invention is not limited to the exemplary embodiment, and may be variously modified and altered from the disclosure by those skilled in the art to which the present invention pertains. Therefore, the spirit of the present invention should not be limited to the described exemplary embodiments, and all of the equivalents or equivalent modifications of the claims as well as the appended claims belong to the scope of the spirit of the present invention.

INDUSTRIAL APPLICABILITY

The present invention may be used in the technical field, such as robots, transporting apparatuses, and moving means, where it is necessary to create various outputs by synthesizing a plurality of inputs.

The invention claimed is:

1. An input synthesis apparatus, comprising:

a first input unit which provides first rotational force;

a second input unit which provides second rotational force equal to or different from the first rotational force;

a gear unit which is engaged with the first input unit and the second input unit and synthesizes the first rotational force and the second rotational force; and

an output unit which outputs resultant force of the first rotational force and the second rotational force,

wherein the gear unit sums up speeds or torque of the first rotational force and the second rotational force based on whether a rotation direction of the first input unit and a rotation direction of the second input unit are identical to each other,

wherein two gears, which are engaged with the gear unit, are formed on one of the first input unit and the second input unit, and a first one-way bearing and a second one-way bearing are formed in the two gears,

wherein a power transmission blocking direction of the first one-way bearing and a power transmission blocking direction of the second one-way bearing are opposite to each other, and

wherein the gear unit includes a third one-way bearing formed on a stationary shaft that does not rotate.

2. The input synthesis apparatus of claim **1**, wherein gears, which are engaged with the gear unit, are formed on the first input unit and the second input unit, respectively, and the number of gears formed on the first input unit and the number of gears formed on the second input unit are different from each other.

3. The input synthesis apparatus of claim 1, wherein a power transmission blocking direction of the third one-way bearing is identical to a power transmission blocking direction of one of the first one-way bearing and the second one-way bearing.

4. The input synthesis apparatus of claim 3, wherein a gear, which is formed with one of the first one-way bearing and the second one-way bearing which has the same power transmission blocking direction as the third one-way bearing, is engaged with a planetary gear unit or a differential gear unit of the gear unit.

5. The input synthesis apparatus of claim 4, wherein a gear, which is formed with one of the first one-way bearing and the second one-way bearing which is different in power transmission blocking direction from the third one-way bearing, is engaged with a gear formed with the third one-way bearing.

6. The input synthesis apparatus of claim 5, wherein the gear unit includes a first input gear which is formed on the first input unit, and a second input gear and a third input gear which are formed on the second input unit, and the planetary gear unit or the differential gear unit are formed to be engaged with the first input gear, and engaged with the second input gear or the third input gear.

7. The input synthesis apparatus of claim 6, wherein the first one-way bearing and the second one-way bearing are formed in the second input gear and the third input gear, respectively.

8. The input synthesis apparatus of claim 7, wherein the planetary gear unit includes:

a first intermediate gear which is engaged with the first input gear;

planet gears which are formed on the first intermediate gear and revolve in a rotation direction of the first intermediate gear;

a sun gear which is formed between the planet gears and rotates in a direction opposite to a rotation direction of the planet gears;

a ring gear which is engaged with the planet gears and rotates in a direction identical to the rotation direction of the planet gears;

a second intermediate gear which has the ring gear formed therein, rotates in the same direction as the ring gear, and is connected to the output unit; and

a third intermediate gear which is connected with the sun gear through the same rotating shaft,

the third intermediate gear is engaged with the second input gear, and the second intermediate gear is engaged with the third input gear.

9. The input synthesis apparatus of claim 7, wherein the differential gear unit includes:

a first intermediate gear which is engaged with the first input gear;

a first bevel gear which is formed on a planar portion of the first intermediate gear;

idle gears which are engaged with the first bevel gear;

a second intermediate gear to which a rotating shaft on which the idle gears are rotatably formed is connected and which rotates in a direction identical to a revolution direction of the idle gears;

a second bevel gear which is engaged with the idle gears and formed to face the first bevel gear; and

a third intermediate gear which has a planar portion on which the second bevel gear is formed,

the output unit is connected to the rotating shaft on which the idle gears are formed,

the third intermediate gear is engaged with the second input gear, and the second intermediate gear is engaged with the third input gear.

10. The input synthesis apparatus of claim 9, wherein a fourth intermediate gear is engaged between the second intermediate gear and the third input gear.

11. The input synthesis apparatus of claim 8, wherein the third one-way bearing is formed in the third intermediate gear.

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